vaginal ultrasonography, permitting a confirmation of viability. This technique also permits direct visualization of ectopic pregnancies in many cases, allowing patients to go directly to laparotomy without the need for other diagnostic procedures.

The procedure is equally capable of detecting and characterizing disease involving the uterus, adnexa, and surrounding structures. Small ovarian masses and uterine leiomyomas can be shown. Fallopian tube dilatation, which usually has a nonspecific appearance on transabdominal ultrasonography, can be specifically diagnosed using the endovaginal method.

Despite the advantages of the procedure, most investigators continue to use it as an adjunct to transabdominal ultrasonography. In one prospective study comparing the two techniques, however, endovaginal ultrasonography provided more information in 65 of 108 nonpregnant patients and was judged inferior in only 4 instances. It was concluded that the endovaginal method could become the initial approach for routine pelvic sonography, with the use of the transabdominal approach advocated in selected patients.

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Percutaneous Cholecystostomy for Acute Cholecystitis

CHOLECYSTECTOMY is the accepted method of treating patients with acute cholecystitis. Because emergency cholecystectomy for acute cholecystitis is associated with a higher mortality rate than an elective procedure, some suggest delaying cholecystectomy until a patient is less ill. Cholecystostomy has been advocated to decompress the inflamed gallbladder until the patient's condition allows a definitive cholecystectomy. Recent reports have shown that percutaneous cholecystostomy may be helpful in managing patients admitted to hospital with suspected acute cholecystitis.

Several catheter systems have been developed for percutaneous cholecystostomy. The catheters all have a securing device such as a Cope-type loop to prevent catheter dislodgement from the gallbladder. Although ultrasonography, computed tomography, and fluoroscopy have been used to guide catheter insertion, ultrasonography is the most frequently used method to guide percutaneous cholecystostomy. Its advantage is that the equipment is portable and therefore the entire procedure can be done at a patient's bedside.

The cholecystostomy catheter may be inserted by one person under ultrasonographic guidance. After the gallbladder is located with ultrasonography and using only local anesthesia, the catheter system is placed transhepatically under real-time control into the gallbladder. After the catheter is placed, a specimen of bile is taken for culture and the catheter is positioned for intermittent suction. A fluoroscopy-guided cholangiogram through the catheter is usually not done until 48 hours after catheter insertion.

Reports of percutaneous cholecystostomy have shown that major complications, such as catheter dislodgement or hemorrhage, are few, the incidence comparing favorably with that of complications from surgical cholecystostomy.

In a few instances of gangrenous cholecystitis, cholecystostomy may not prove helpful and patients will require emergency cholecystectomy. In most circumstances, however, the patient's condition improves after catheter placement, and further treatment, such as a cholecystectomy, can be delayed. In fact, in a large number of patients in hospital, especially those with acute acalculous cholecystitis, percutaneous cholecystostomy has proved to be a definitive treatment, thus completely avoiding cholecystectomy.

Percutaneous cholecystostomy may be a safe and beneficial method to manage patients with suspected acute cholecystitis.

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Gadolinium in Magnetic Resonance Imaging of the Central Nervous System

MAGNETIC RESONANCE IMAGING (MRI) has become an important initial method for the diagnostic imaging of diseases of the central nervous system. Magnetic resonance imaging, however, has difficulty in distinguishing the alteration of the blood-brain barrier of a localized pathologic lesion that may be surrounded by extensive edema. This difficulty has prompted the development of gadolinium-labeled diethylenetriaminepentaacetic acid (Gd-DTPA), known in the United States as gadopentetate dimeglumine (Magnevist). The availability of Gd-DTPA as an approved contrast agent for use in diagnosing central nervous system disorders has revolutionized the capabilities of MRI. It is now possible not only to identify a localized or diffuse disorder with great sensitivity but also to demonstrate the alteration of the blood-brain barrier following the intravenous administration of Gd-DTPA.

A wide variety of both intra-axial and extra-axial tumors are optimally visualized following the administration of Gd-DTPA. Metastatic brain tumors as small as 2 to 3 mm may be shown following Gd-DTPA enhancement. Gd-DTPA-enhanced MRI is now the imaging procedure of choice for patients with possible metastatic disease to the brain or spinal cord. Metastatic disease to the meninges may be difficult to show with conventional x-ray computed tomography because of the Hounsfield artifact problem. This limitation is resolved with MRI. In the presence of meningeal tumor deposits, there is notable enhancement of the dural margins following the administration of Gd-DTPA.

Images of infections of the meninges, either acute or chronic, and parenchymal infections such as an abscess or fungal granuloma usually are enhanced after a Gd-DTPA infusion. Aneurysms and arteriovenous malformations are well shown on conventional MRI scans. Enhancement is variable, depending on the rate of flow through these lesions. High flow regions within arteriovenous malformations or aneurysms will not be enhanced. The visualization of areas of slow flow in venous or cryptic malformations may be improved with contrast enhancement.

Gd-DTPA-enhanced MRI has become the state-of-the-art method of imaging a variety of abnormalities. It has

none of the risks associated with iodinated contrast agents used with x-ray computed tomography. The use of Gd-DTPA solves some of the diagnostic problems associated with unenhanced magnetic resonance scans. It helps characterize brain abnormalities detected on the conventional scans, assists with the separation of tumor from surrounding edema, and increases the sensitivity for detecting a variety of central nervous system lesions.

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Magnetic Resonance Imaging for Diagnosing Avascular Necrosis of Bone

MOST COMMONLY SEEN in the femoral head, bony avascular necrosis may lead to severe pain and disability if allowed to progress. Avascular necrosis appears both unilaterally and bilaterally. Though it may occur in otherwise healthy persons, people with blood dyscrasia or those on long-term steroid therapy are particularly prone to it. In our experience heavy alcohol users may present with obscure hip pain due to avascular necrosis. It may also develop in patients with a malignant neoplasm who are undergoing chemotherapy. In this group the avascular necrosis is sometimes confused with metastatic disease.

An early diagnosis is crucial to the outcome, for the success rate following surgical decompression is considerably better in patients with mild disease than in those in more advanced stages. Recently magnetic resonance imaging (MRI) has proved to be the most sensitive method available for the early diagnosis of femoral avascular necrosis. In 1987 MRI was found to be 100% sensitive and specific as a screening tool among 32 patients on long-term steroid use, superior to both conventional radiography and scintigraphy by a comfortable margin. Three of seven patients with abnormal MRI findings but normal radiographic and bone scan results were pain-free at the time of evaluation. All later had pathologic findings at a surgical procedure or the eventual development of characteristic radiographic changes. Though cost may limit its adoption, MRI has potential as a screening aid in asymptomatic patients at high risk for avascular necrosis.

Magnetic resonance imaging findings in patients with avascular necrosis depend to some degree on the stage of the disease. Always, however, they involve a relative decrease in signal. On T1-weighted images—T1 and T2 referring to the nuclear spin relaxation times—patches of moderately decreased signal may be seen within the marrow space. With T2-weighting on high-field units (1.5 tesla), there may be a "double-line sign" in which a bright strip of high signal intensity appears within an area of decreased signal. The use of both T2- and T1-weighted imaging may increase the sensitivity of MRI in detecting avascular necrosis.

We advocate the use of MRI of the hips in patients who are seen for hip pain and patients who have a predisposition for avascular necrosis.

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Biliary Lithotripsy

BILIARY LITHOTRIPSY or extracorporeal shock-wave lithotripsy (ESWL) for gallbladder stones is an exciting new alternative to standard cholecystectomy. Biliary ESWL may be used to treat stones in the intrahepatic and extrahepatic bile ducts, as well as in the gallbladder. At present these procedures are considered investigational in the United States.

Shock waves may be produced by various means. The spark-gap method uses a spark plug submerged underwater to generate the shock waves. The electromagnetic technique uses an oscillating membrane and a lens, and a third method, the piezoelectric technique, uses piezoceramic crystals. The shock waves emanate from these generators and are focused by a juxtaposed semiellipsoid cup or a lens onto the gallstones. Stones will fragment if the shock-wave energy overcomes the inherent forces of the gallstones.

All ESWL systems are efficacious to varying degrees. The major advantage of the spark-gap method is the power and efficacy of stone fragmentation; the piezoelectric machines are less powerful and commonly require more than one treatment session. The piezoelectric lithotripters cause only minimal patient discomfort, however, and require no analgesia. In most ESWL gallstone protocols in this country, patients are in the hospital for only one night.

The differences between biliary and renal lithotripters include the following: ultrasonography is used for localization rather than fluoroscopy, a water membrane has replaced the water bath, and focusing of the semiellipsoid has been improved, which helps reduce patient discomfort. Currently general or epidural anesthesia is unnecessary for gallstone lithotripsy; epidural anesthesia is used for bile duct ESWL.

In experimental and investigational in vivo studies, biliary ESWL has been relatively safe to date. Mild soft tissue damage in the form of petechiae, hemorrhage, and vascular thrombosis appears to be reversible within a week. Acute injury necessitating cholecystectomy has not been reported.

The success rate of ESWL fragmentation has been more than 90% in most early studies on patients. Only 15% to 30% of patients with symptomatic gallstones qualify for ESWL. Qualification criteria include no more than three stones, no stone greater than 3 cm, the cystic duct must be patent, the patient has symptoms related to gallstone disease, there is no jaundice or evidence of common duct stones, the patient must not be pregnant, there is no aneurysm or cyst in the path of the shock waves, and there must not be evidence of acute cholecystitis or pancreatitis.

The most common side effect of biliary ESWL is transient biliary colic, which occurs by intermittent obstruction and the passage of small fragments through the cystic duct. This occurs in about a third of patients. Other side effects include transient cutaneous petechiae and microscopic hematuria; these are self-limited. Pancreatitis due to stone passage has been extremely uncommon.

The advantages of ESWL include the avoidance of general anesthesia, a major operation, and an abdominal scar.